

Zero Net Energy Buildings Outreach and Action Plan January 1, 2000

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Section I. Solar Buildings Vision: Zero Net Energy Buildings

Solar Buildings Mission

To combine solar energy technology with energy-efficient construction techniques to help create a new generation of cost-effective buildings that have zero net annual need for fossil fuel energy.

Solar Buildings Vision

By the year 2020, the United States will be constructing a significant number of buildings that:

- meet their own energy needs by utilizing solar or other renewable resources,
- have no on-site or off-site carbon emissions,
- reduce utility peak electrical demand,
- optimize the health and productivity of their occupants, and
- provide energy security from natural disasters and extended power outages.

Background

The Need: Buildings use two thirds of all electrical energy consumed in the United States and are responsible for one third of peak electrical demand. Because buildings are typically used for 50–100 years, their inertia has a major impact on future energy use patterns. Recognizing this enormous impact, the U.S. Department of Energy’s (DOE) Office of Building Technology, State and Community Programs (BTS) has a goal of reducing energy use in new buildings by 50% as part of the “Buildings for the 21st Century” strategic plan. In addition, the mission of DOE’s Office of Power Technologies (OPT) is to develop clean, competitive energy technologies for the 21st century. However, a coordinated long-term program is needed that integrates the goals of both of these DOE offices in order to help promote the widespread construction of new buildings that can supply their own energy from renewable resources, rather than by consuming non-renewable energy from fossil fuels.

The Opportunity: Several DOE and electric utility energy efficiency programs carried out in the 1990s have demonstrated cost-effective new buildings with 60%–80% overall annual energy savings compared with energy-code compliant base case buildings. Continuing improvements in the energy performance of building enclosures, glazings, lighting systems, HVAC systems, controls, and office equipment can further reduce new building energy requirements. With reduced building loads, solar technologies can offer the opportunity to achieve “zero net annual energy use” in new buildings. In fact, some zero net energy (ZNE) buildings have already been completed; however, the challenge is to achieve cost-effective and affordable ZNE buildings. Clearly, widespread construction of ZNE buildings would also contribute significantly to U.S. economic and environmental health.

Objectives

The Solar Buildings Vision has the following key objectives, which will be reached by 2020:

- Construct 100,000 affordable ZNE homes a year in the United States
- Construct 20,000 cost-effective ZNE schools, offices, and other non-residential buildings a year in the United States
- Achieve nationwide ZNE consumption in new federal buildings.

Work Plan

The following three-phase program is envisioned to accomplish these program objectives.

Phase I: Establish Long-Term Plan, Support, and Performance Targets

The first phase is intended to fully develop a comprehensive plan for achieving the Solar Buildings Vision, and to build a broad-based coalition of supporters to maximize potential for the Vision's sustainability. Phase I will last approximately 2 years. Probable Phase I work tasks include the following:

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| Task I.A | Develop Solar Industry and Building Industry Support |
| Task I.B | Perform a System Study to Determine the Optimal Mix of Solar Technologies and Energy-Efficient Building Features in U.S. Climates |
| Task I.C | Develop Detailed Program Performance Targets and Milestones |
| Task I.D | Develop Detailed Implementation Plan and Funding Requirements |
| Task I.E | Develop Program Evaluation Criteria (i.e., Define System Benefits) |

Phase II: Develop ZNE Building Technologies and Implement Cost-Effective Prototypes

The second phase is intended to begin the implementation of the Solar Buildings Vision, and to demonstrate program success by completing cost-effective prototype projects in at least three U.S. climate regions. Phase II will last approximately 8 years. Probable Phase II work tasks include the following:

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| Task II.A | Manage, Coordinate, and Conduct Solar Technology Research and Development [in parallel with Phase I]: Lowering the cost of solar thermal space heating and water heating, solar air-conditioning, building-integrated photovoltaics (PV), hybrid solar lighting, thermochromic glazing, and natural cooling strategies |
| Task II.B | Hold Design Competition for Prototype ZNE Buildings |
| Task II.C | Promulgate Prototype ZNE Buildings |
| Task II.D | Monitor Progress Toward ZNE Buildings |
| Task II.E | Educate the Building Industry about the Solar Buildings Vision and Its Progress. |

Phase III: Accomplish Nationwide Zero Net Energy Performance in New Buildings

The third phase is intended to follow up the implementation phase of the ZNE Buildings prototypes to encourage the U.S. building construction industry to adopt the ZNE Buildings concept and share the Solar Buildings Vision. A ZNE Buildings Technology Roadmapping process will be conducted with building industry stakeholders to identify the research and marketing transformation activities necessary to make the ZNE Buildings concept a widespread reality. In addition, Phase III builds toward the nationwide success of the vision such that the maximum net energy supplied to all new residential and commercial U.S. government buildings constructed during or after the year 2020 is zero. Phase III work tasks leverage the successes of Phase II efforts and will last approximately 10 years.

Program Support

In November 1999, several members of the solar industry, DOE, the National Renewable Energy Laboratory (NREL), and Sandia National Laboratories (Sandia) met to discuss this Solar Buildings Vision. The consensus reached at that meeting led to the creation of this document. Additional industry support is needed to refine and implement the vision. Alliances must be formed between the solar industry and the buildings industry to fully integrate solar technology into the design of buildings. The cost of solar technology must be reduced and commercial products developed.

DOE's Solar Buildings Program is fully supportive of this vision and is proposing to restructure its activities to provide the necessary solar research and coordination with related DOE programs. NREL, Sandia, and Oak Ridge National Laboratory have also expressed support for the vision and will either conduct or contract the necessary solar research.

Congressional support is also required if we are to initiate activities that promote the Solar Buildings Vision. Beginning in February 2000, Congress will debate the merits of the vision in preparation for assigning it a FY 2001 budget. Industry support is needed to convince Congress to fully fund the DOE Solar Buildings Program budget request.

Budget

The proposed annual program budgets for the Solar Buildings Vision are as follows:

Phase I (FY 2000-2001):	\$6,000,000
Phase II (FY 2002-2010):	\$20,000,000
Phase III (FY 2011-2020):	\$30,000,000

Benefits

A successful Solar Buildings Vision will:

- reduce U.S. energy consumption by 42 trillion Btu per year by the year 2020, and
- reduce U.S. emissions by 0.7 million metric tons carbon equivalent per year by the year 2020.

In addition, the Solar Buildings Vision will:

- ensure a major U.S. role in technologies required for a sustainable global economy,
- reduce the need for additional U.S. electrical generation and distribution infrastructure,
- improve the United States' competitive position by reducing the energy cost component of most products and services,
- enhance national security by fostering distributed, on-site energy production capability,
- align with current majority public opinion supporting sustainable development,
- educate American homebuyers on the benefits of energy efficiency and renewable energy,
- set a "stretch" target for the U.S. solar and building industries, and
- "leapfrog" existing market resistance to energy efficient and renewable energy technologies.

Section II. Timeline

1/10/99	Communicate ZNE Buildings concept to Solar Industry
1/14/00	Identify core stakeholders and familiarize them with Program Vision, timeline, and “talking points”
1/30/00	Identify remaining stakeholders and familiarize them with Program Vision and “talking points”
2/1/00	Obtain solid commitments of support for concept from core stakeholders and, where possible, from remaining stakeholders
2/15/00	Accumulate and assemble sufficient background technical information to carry the message through 3 rd quarter 2000
2/15/00	Begin outreach to key policymakers
3/16/00	Conduct “peer review” and garner additional input on Solar Buildings Program direction from invited participants
4/19-4/22/00	Conduct progress and update meeting in conjunction with Soltech 2000

Section III. Talking Points

- Buildings use two thirds of all electrical energy consumed in the United States.
- Buildings are responsible for one third of peak electrical demand in the United States.
- Buildings are typically used for 50–100 years; their energy consumption inertia therefore has a major impact on future energy use patterns.
- Research is needed to quantify the contribution that various technologies can contribute toward the ZNE Buildings goal in different climates and for different building types.
- On-site heat generation for water and space heating purposes can only be accomplished with small-scale solar thermal technologies or with fossil-fueled systems.
- Research is needed to lower the cost of solar water heaters that can also be used for space heating and solar-assisted heat pumps in temperate climates. (Heat pumps utilize relatively low temperature energy resident in ambient air and in the ground to produce heat.)
- On-site electricity generation can only be accomplished with photovoltaic (PV) technologies (either mounted on the exterior of a structure or integrated into the structure itself) or with fossil-fueled technologies.
- Research is needed to integrate PV with air conditioning systems, energy efficient building techniques, and natural cooling strategies for hot climates.
- Research is needed to lower the cost of hybrid solar lighting systems that utilize sunlight for both electricity generation and interior lighting.
- Advanced insulation and fenestration construction techniques allow buildings to minimize heat loss in cold climates and minimize heat gain in warm climates.
- Passive solar construction techniques allow buildings to collect solar heat and reject excess heat when necessary.
- **The End Product:** A comprehensive plan for designing and constructing buildings that generate all of the energy they require through the combination of solar energy, energy efficiency, and other renewable energy generation technologies.